

REMARKS

Claims 1-11 were pending in the present application. By virtue of this response claim 8 has been amended without prejudice or disclaimer of any previously claimed subject matter. Accordingly, claims 1-11 are currently under consideration. Amendment and cancellation of certain claims is not to be construed as a dedication to the public of any of the subject matter of the claims as previously presented. Support for the amendment appears, for example, on pages 7-9 of the present application.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attachment is entitled "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

Rejections under 35 U.S.C. §102(e)

Claims 1-6 were rejected under 35 U.S.C. § 102(e) as being anticipated by Kimura et al., U.S. Patent No. 6,201,823 (hereinafter "Kimura").

Applicants respectfully traverse the rejection. Initially, Applicants note that the nitride semiconductor light-emitting device recited in claim 1 comprises a GaN substrate having a crystal orientation that is slightly inclined within a range of 0.05° to 2° against a <0001> plane. This varies the growing condition of the nitride semiconductor provided on the GaN substrate, thereby reducing dislocation and aggregation of In disposed within an active layer. The smoothness of the active layer improves the quality of the active layer as well as the properties of the device. The p-type contact resistance can be reduced without particularly performing a p-type properties impairment process, thereby enabling efficient current injection, as described on page 17, lines 5-11 of the present application.

The incline of the surface of GaN substrate as claimed at the limited angle between 0.05° to 2° provides improved results. The claimed device has improved properties such as low resistance p-type contact, reduced threading dislocations, improved flatness, and improved emission characteristics, as described on page 18, lines 1-12 of the present application.

In particular, claim 1 is distinguished over Kimura for at least the following reasons. Kimura does not disclose or suggest a nitride compound semiconductor light emitting device comprising, in part, "a GaN substrate having a crystal orientation which is tilted away from a $\langle 0001 \rangle$ direction by an angle which is equal to or greater than about 0.05° and which is equal to or less than about 2° ."

The Examiner refers to n-type GaN contact layer 103 of Kimura as the GaN substrate. Kimura, however, discloses merely that the base region of the device may include GaN based semiconductors, not a GaN substrate. (Kimura: col. 6, lines 13-20). For example, Kimura discloses in embodiments (1-6) that the substrate is a sapphire substrate. (Kimura: col. 18, line 9-11; col. 22, lines 36-38; col. 27, lines 6-8; col. 30, lines 62-64; col. 35, lines 15-17; and col. 40, lines 38-40). Kimura, however, fails to disclose or suggest a GaN substrate as recited in claim 1. In contrast to Kimura, claim 1 recites a GaN substrate, which is particularly used because of specific problems associated with using a sapphire substrate in a nitride compound semiconductor light emitting device. For example, as discussed in the present application, at least from page 5, line 8 to page 6, line 7, the use of a sapphire substrate leads to problems such as the inactivation of Mg and unfavorable influences on the InGaN multiple quantum well layer. Therefore, the elements of claim 1, and in particular, a GaN substrate, are not disclosed or suggested by Kimura. Accordingly, Applicants request withdrawal of the rejection.

Rejections under 35 U.S.C. §103(a)

Claims 7-11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kimura in combination with Yuge et al., U.S. Patent No. 6,030,848 (hereinafter "Yuge").

It is believed that claim 7, a device claim, should have been included in the § 102 rejection above. In any event, claim 7 depends from claim 1 and is allowable for at least the same reasons stated above in regard to claim 1.

Claim 8 has been amended to recited a method for producing a nitride compound semiconductor light emitting device wherein "an acceptor doping layer is integrated on a GaN substrate having a crystal orientation which is tilted away from a <0001> direction by an angle which is equal to or greater than about 0.05° and which is equal to or less than about 2°." As discussed above, Kimura fails to teach a semiconductor device, or a method of making a semiconductor device, wherein the substrate is GaN. In contrast to amended claim 8, Kimura discloses in embodiments (1-6) that the substrate is a sapphire substrate. A GaN substrate is particularly used in claim 8 because of certain problems associated with using a sapphire substrate, as discussed in the present application, for example from page 5, line 8 to page 6, line 7, such as the inactivation of Mg and unfavorable influences on the InGaN multiple quantum well layer. Therefore, the elements of claim 8, in particular, a GaN substrate, are not disclosed or suggested by Kimura.

Kimura further does not teach or suggest the method claimed wherein the GaN substrate is tilted, or wherein growth of the semiconductor is stopped for a period of time. The advantage of the claimed method, as described on page 19, lines 1-12, page 30, lines 5-17, and page 31, lines 17-23, includes reducing the threading dislocations and eliminating In concentration around the dislocations as well as increasing the strength of the light emitting properties.

Yuge fails to cure the deficiencies of Kimura. For example, Yuge discloses a sapphire substrate as well. (Yuge: col. 3, line 7). Therefore, Yuge alone or in combination with Kimura

fails to disclose or suggest the method for producing a nitride compound semiconductor light emitting device as defined in claim 8. Nothing within the disclosure of Yuge in combination with Kimura provides any motivation to practice the claimed method.

Further, with regard to claim 10, Yuge discloses a method of creating a gas condition with nitrogen after forming an active layer (Yuge: col. 2, lines 48-63; col. 4, lines 48-63). In contrast, claim 10 recites, in part, "supplying a carrier gas into the chamber...during the wait period after at least one of the at least one well layer and the at least one barrier layer has been formed, the carrier gas comprising nitrogen as a main component." Thus, the carrier gas is in the chamber at the time of growing an active layer. Thus, Yuge alone or in combination with Kimura does not disclose the elements of claim 10.

In view of the combined disclosures of Yuge alone or in combination with Kimura, there is no suggestion of the methods defined by claims 8-11. Further, there is no teaching within the disclosures of the applied references that would have motivated one of ordinary skill to practice the method of claims 8-11. The Applicants therefore request withdrawal of the rejection.

CONCLUSION


Applicant has, by way of the amendments and remarks presented herein, made a sincere effort to overcome rejections and address all issues that were raised in the outstanding Office Action. Accordingly, reconsideration and allowance of the pending claims are respectfully requested. If it is determined that a telephone conversation would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Assistant Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing docket no. 299002051800. However, the Assistant Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

Respectfully submitted,

Dated: September 20, 2002

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims

Claims 8 has been amended as follows:

8. (Amended) A method for producing ~~the~~ a nitride compound semiconductor light emitting device according to claim 7, wherein the method comprises:

~~after at least one of the at least one well layer and the at least one barrier layer has been formed, observing a wait period during which no other layers are formed, the wait period having a predetermined length~~ wherein a semiconductor multilayer structure including an active layer of a quantum well structure made by a nitride compound semiconductor and an acceptor doping layer is integrated on a GaN substrate having a crystal orientation which is tilted away from a <0001> direction by an angle which is equal to or greater than about 0.05° and which is equal to or less than about 2°, the active layer including at least one barrier layer and at least one well layer, the method comprising the steps of:

stopping the growth of the active layer for a certain period of time after forming the well layer of the active layer including the at least one barrier layer and at least one well layer; and

stopping the growth of the nitride compound semiconductor for a certain period of time after forming the nitride compound semiconductor which contacts with the well layer and becomes the barrier layer having band-gap energy larger than that of the well layer.

9. (Amended) A method according to claim 8, wherein the predetermined length of ~~the~~ a wait period is equal to or greater than about 1 second and is equal to or less than about 60 minutes.

10. (Amended) A method according to claim 8, further comprising:

supplying a carrier gas into the chamber, in which the GaN substrate is placed, during ~~the~~ a wait period after at least one of the at least one well layer and the at least one barrier layer has been formed, the carrier gas comprising nitrogen as a main component.

11. A method according to claim 8, further comprising:

supplying a carrier gas and a group V gas into a chamber, in which the GaN substrate is placed, during ~~the~~ a wait period after at least one of the at least one well layer and the at least one barrier layer has been formed, the carrier gas comprising nitrogen as a main component.